

# Estimation of the Exact Floor Information Using Mobile-Embedded Sensors

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*Abstract: Producing and providing location information over the last decades has been repressed especially by the development and extensive use of Location Based Services (LBS), which efficiently improve the use of sensor technologies such as location, temperature, pressure, humidity etc. in producing initial data or information to be used within the application. LBS can be defined as geographically oriented data and information service to users across mobile telecommunication networks. In this context, 3 dimensional (3D) location information is mostly provided by Global Navigation Satellite Systems (GNSS) sensors embedded into smartphones. However, GNSS cannot provide 3D location information with sufficient accuracy in indoor spaces by the use of existing technologies. Therefore, several methods using RFID, Bluetooth tag, wireless sensor network (WSN), Near Field Communication (NFC) tag and/or Wi-Fi technologies have been developed in order to support 3D positioning applications in indoors. Additionally, UWB radio signals coupled with the inertial measurements provided by the use of Micro Electro Mechanical Sensors (MEMS) in an extended Kalman filter in order to improve the filter performances for the use of indoor navigation.*

*In addition to above stated, use of pressure sensors for especially determination of 3D locations of the users in indoors were investigated by several researchers based on the theoretical information of inverse proportion between pressure and height. In order to improve the quality of the estimation of the height information various methods as Kalman Filtering, which estimates the instantaneous state in Linear Quadratic Gaussian (LQG) problems by using measurements linearly related to the state but corrupted by white noise, were applied in practice.*

*The main objective of this paper is to present a methodology for determining the floor information of a smartphone equipped with embedded Micro Electro Mechanical sensors (MEMs) in a multi storey building using sensors data. The methodology has used data provided by NFC tag as initial information, and then sensor data obtained by pressure, accelerometer, and gravity sensors of the smartphone have been used for determining exact floor information accurately. Kalman Filtering has supported presented methodology in order to eliminate drifts in pressure sensor data. Differently from the existing studies sensor data collected for estimating the height information were processed in a time series.*

*In this study, the proposed methodology was implemented as an Android application and it was evaluated by applied experiments in different multi storey buildings (buildings with 6 and 17 floors) in different days. Application determined floor changes and initial floor number accurately in all experiments. Accuracy assessment results confirmed the success of the implemented mobile application.*

**Keywords:** Indoor navigation, MEMs sensor, kalman filtering, smartphone positioning